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Review of Defence Annual Report 2002-2003

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Joint Standing Committee on Foreign Affairs, Defence and Trade
Defence Sub-Committee

ROYAL AUSTRALIAN AIR FORCE

AIR FORCE SUBMISSION TO JOINT STANDING COMMITTEE ON FOREIGN AFFAIRS, DEFENCE AND TRADE

CONSIDERATION OF DEFENCE INPUT TO DEFENCE ANNUAL REPORT FOR FY02/03

AIR COMBAT CAPABILITY

ROYAL AUSTRALIAN AIR FORCE

AIR COMBAT CAPABILITY PAPER FOR JOINT STANDING COMMITTEE ON FOREIGN AFFAIRS, DEFENCE AND TRADE

CONSIDERATION OF DEFENCE INPUT TO DEFENCE ANNUAL REPORT FOR FY02/03

BACKGROUND

1. The Joint Standing Committee on Foreign Affairs, Defence and Trade (JSC FAD&T) considered the review of the Defence Annual Report 02-03 on 15 December 2003. Subsequently, following a private submission to the Committee, CAF with an expert team, attended a closed meeting of the Committee on 23 March 2004, to provide classified information and to address some Committee member issues.

2. As a result of that meeting, CAF has been asked to provide a publicly releasable paper to address:

   a. the decision to retire the F-111;

   b. the Defence statement that no capability gap will eventuate following retirement of the F-111; and

   c. the decision to sole source the selection of the new air combat capability to the Joint Strike Fighter (JSF),

3. CAF agreed to provide the Air Force response to the Committee by mid-May 2004. However, given that much of the discussion will require the use of classified information, this non-classified document is not stand alone.

4. This paper will discuss the future Air Force and how that air combat capability is expected to develop over time.

FUTURE AIR FORCE – DRIVERS OF CAPABILITY

Overview

5. In the next 20 years, Australia's strategic environment will be shaped by a variety of trends and factors. One of the most important factors will be the development of more sophisticated military capability. In our region, the trend towards more effective air combat, ground based air defence and information capabilities will continue. Many nations in our region have acquired, or plan to acquire, advanced air combat aircraft with 'Beyond Visual Range' (BVR) and 'Look-down Shoot-down' capabilities. Ground based sensors and command and control capabilities are also being enhanced. In order to maintain our qualitative edge in this emerging environment, Australia will need to move away from a platform-centric approach to air warfare towards the development of a networked system of systems that will achieve the required combat effect in both a joint and combined environment. Put simply, we will need to focus on our ability to exploit information and

communication systems to build and maintain our capability edge by developing a network-centric capability system.

6. The ADF will exploit communications and information technology to develop a system of systems that will prevail in the network centric warfare environment of the future. The Air Force system will be an important part of the overall ADF system providing sensors, shooters and command, control and communications infrastructure and architectures. The combat effect of the ADF system should exceed the sum of the its individual parts. This will be achieved by careful design of the system architecture and, by exploiting data link information technology, we will be capable of displaying a common picture of an engagement shared between all participating sensors, shooters and command and control nodes within the system. Vital information on adversary movements will be passed pictorially in real-time, thereby improving the situational awareness of all participants. Everybody will be working from a common view of adversary, friendly and neutral activities. This improved and common situational awareness will markedly improve air combat lethality and survivability in both the air control and strike environments.

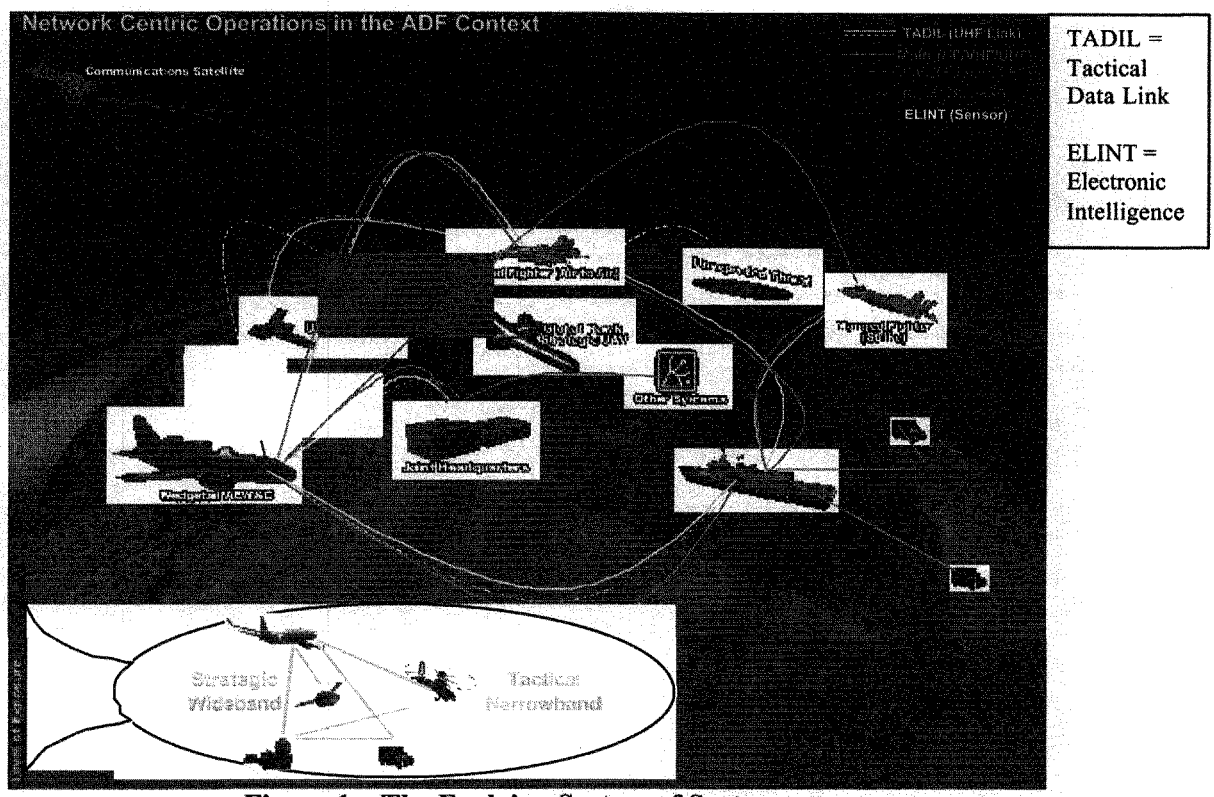

Figure 1 – The Evolving System of Systems

7. In the air control environment, air to air shooters within the system can remain passive (ie leave their radars and other emitters turned off) thereby reducing their probability of detection. The shooters can rely on the information passed by Airborne Early Warning and Control (AEW&C) aircraft, other sensors such as the Jindalee Over-the-horizon Radar Network (JORN), other participants or the command and control centre. This will enable our air defence pilots to *see first, shoot first and kill first*. Similarly, in the strike environment, our multi-role shooters can remain passive with the system providing all necessary pictorial information on the adversary's air and ground based air defence capabilities in the vicinity of the various targets. In the air combat environment of the future, a capable and well-designed

networked system should always prevail over an adversary that is not supported by a similar system, even though that adversary might possess highly capable platforms.

Key Air Combat Factors

8. The critical factors that will enable the vision for our future combat capability to be realised include:

a. our ability to achieve control of the air;

b. the capability provided by the information, surveillance and reconnaissance (ISR) network;

c. the advantage bestowed by the system;

d. persistence in the battlefield; and

e. targeted and controlled precision effects.

9. **Control of the Air**. Control of the air requires the ability to detect, locate, target and destroy enemy air assets that can influence the outcome of any engagement, regardless of whether those engagements are in the land, maritime or air environments. Control of the air is essential to the success of any engagement in any environment.

10. **The ISR Network**. Shared situational awareness is critical for generating effective strike operations. AEW&C and the Air Defence Ground Environment (ADGE) supported by ground based radars and JORN will be the key sensors and will provide a level of information exchange and situational awareness unprecedented in the ADF - a force multiplier for the strike and control of the air operations.

11. **Systemic Advantage**. The power of the system will determine the outcome of any engagement and can overcome potential imbalances in single platform capabilities. The system is required to provide a single pictorial view of the engagement and will be achieved by fusing information from multiple sources into a seamless view of all activities in the battlespace.

12. **Persistence**. The introduction of the Air to Air Refuelling aircraft around 2008 will improve operational flexibility and persistence. In addition, introduction of the High-Altitude Long-Endurance (HALE) Unmanned Aerial Vehicle (UAV) will provide a long range and persistent ISR capability that will be critical for undertaking precision targeting.

13. **Strike Effects**. The future strike capability will have weapons and systems that are optimised to achieve the desired effects rather than applying excessive effects. This will be achieved with weapons matched to targets and systems that can provide the necessary delivery accuracy. Being able to deliver weapons with increased accuracy brings about fundamental changes to the required size of weapons, with reduced explosive content and less likelihood of collateral damage. The reduction in the mass of the weapon enables more of these smaller weapons to be carried resulting in a greater strike capability being delivered from smaller combat aircraft than is possible today.

THE LEGACY STRIKE CAPABILITY (2004)

The F-111

14. Australia purchased 24 R/F-111C aircraft in 1968 and these were introduced into service in 1973 following initial problems. After some aircraft losses following accidents,

Australia purchased additional F-111A aircraft in the 1980s and upgraded them to F-111C configuration. During the 1990s, an additional 15 F-111G were purchased, although these aircraft were not upgraded to an operational strike configuration. These F-111G aircraft have been used for spares and training and have enabled fatigue and usage to spread over a larger fleet.

15. Australia has an operational fleet of 16 F-111C strike aircraft, four RF-111C reconnaissance aircraft and seven F-111G training aircraft. An additional five F-111G are in long term storage with a further two aircraft having been broken down for spares and one has been lost in an aircraft accident. A seventeenth F-111C strike aircraft was severely damaged during an incident when fuel tank vapours detonated following a short circuit in the wiring loom of a fuel tank pump. The cost of restoring this aircraft to flying condition may be uneconomic given the plan to withdraw the capability around 2010.

Cost of F-111 Capability

16. No military combat aircraft operator has been able to predict with precision the way an ageing aircraft fleet will behave. Signs of obsolescence and increasing maintenance effort usually become evident after 10-15 years of operation, driven by the cumulative reliability of the thousands of components that make up an aircraft, wear and tear, and the effects of time. Modifications to aircraft, as was the case with the F-111 Avionics Update Program (Project Air 5225) during the late 1990s, may arrest the trend but will never do so completely. Unforeseen maintenance costs inevitably will arise and new issues will emerge. The Sole Operator Program was designed to manage the issues as cost effectively as possible.

17. Figure 2 illustrates the broad cost of ownership in cash terms that would be required if the F-111 aircraft were retained to 2020. The rough order of magnitude investment - 'ROM Investment' represents an estimate for those Table 1 projects that are uncosted but would be required to develop the F-111 in step with the future vision for Air Force.

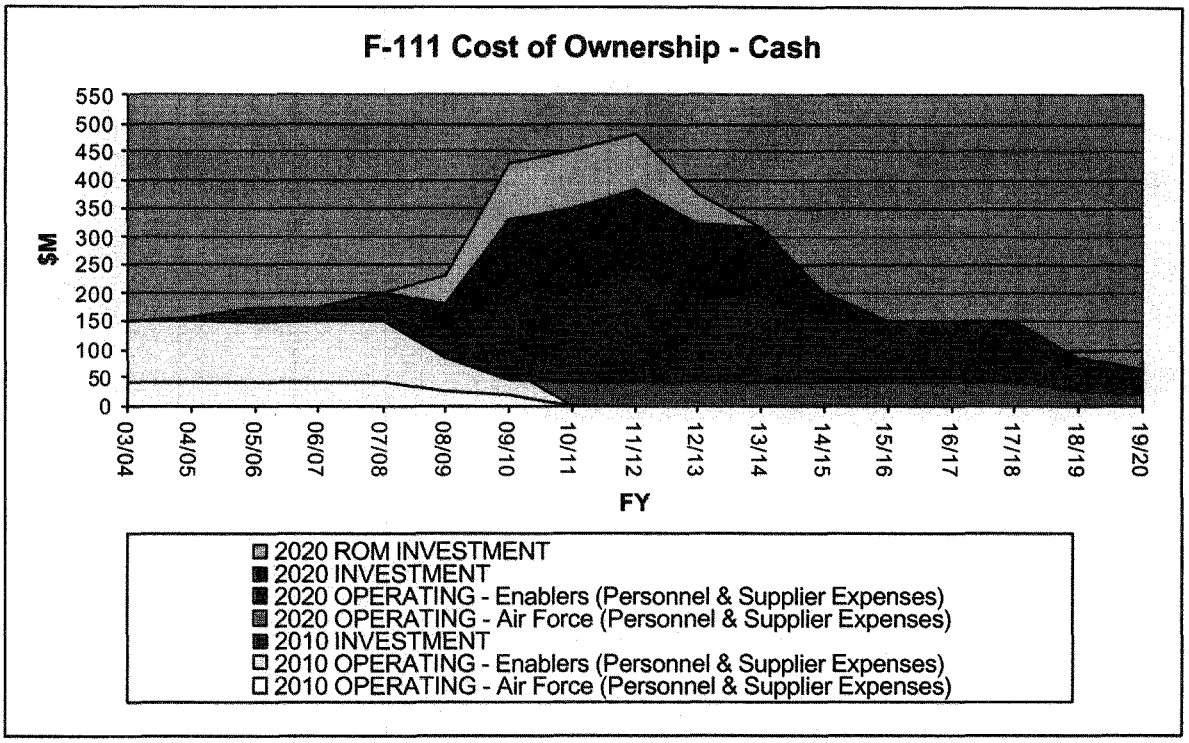

Figure 2 – Broad Cost of Ownership by Category

Description		PWD 2010	PWD 2015-2020
Projects			
Air 5398	AGM-142	$42m	$42m
Air 5409	Bomb Improvement Program (F-111 Integration)	$0m	$20-$30m
Air 5416	F-111 EWSP/RWR	$30-$50m	$150m-$200m
Air 5418	FOSOW (F-111 Integration)	$0m	$100m-$150m
Air 5421	Reconnaissance LOTE	<$10m	$50m-$75m
Air 5426	Strike Capability Enhancement	$0m	$200m-$250m
Uncosted Additional Projects			
JP 2089 Phase 2	TIED (Data Links)	$0m	Additional cost
JP 5408	ADF GPS Enhancement	$0m	Additional cost
JP 90 Phase 1	ADF IFF	$0m	Additional cost
JP 2030 Phase 5B/7B	Mission Planning Systems	$0m	Additional cost
Capital Equipment		**$50m-$75m**	**$600m-$750mm**
Personnel and Op Costs FY04-14		**$1210m**	**$1665m**
Logistics Supplementation FY04-14		**$31m**	**$425m**
TOTAL (Across the decade FY04-14)		**$1000m-$1500m**	**$2500m-$3500m**

Table 1 - Ten Year Cost of Retaining F-111 in Service

18. One of the best indicators of likely future problems and costs is the experience of lead operators. Lessons learned can be applied in a measured fashion thus containing the impact that emerging issues have on maintenance costs and aircraft availability. Very often, Australia is able to watch the experience of other operators. However, the USAF withdrew their F-111s from service in 1998, so this indicator is no longer available for the F-111. The response to the USAF withdrawal was to acquire an expanded inventory of spares and to invest in a number of test programs to identify possible future maintenance issues including the sole-operator program in DSTO. The Sole Operator Program approach was successful in

identifying the wing fatigue problem that arose in 2002 but nothing anticipated the fuel tank explosion incident later that year. The lesson from these and other general experiences is that ageing aircraft have increasing uncertainty attached to their technical integrity. This normally manifests itself as declining availability and unscheduled repair arisings that are challenging to manage. While Air Force, the Defence Materiel Organisation, the Defence Science and Technology Organisation and Boeing Australia demonstrated an ability to respond to these unanticipated arisings, there is a significant risk that we might not cope with future arisings. Furthermore, recovery will be costly and rate of effort will be curtailed during the recovery period, as occurred in the in the two instances mentioned above.

19. Air Force planning anticipates the rate of effort recovering to near historical levels, but there is not a high level of confidence that this will be achieved. In all likelihood the F-111 fleet will be characterised by an increasing budget and under-achievements in rate of effort. The magnitude of the likely F-111 costs over the period FY 11/12 to FY 14/15, and the opportunity cost this would have to the rest of the Defence budget, has convinced Defence planners that retaining the F-111 in-service beyond about 2010 is simply not a viable option.

20. Somewhat paradoxically perhaps, Figure 2 does not predict an increasing cost of ownership out to the 2010 retirement point. This containment in cost results purely from the decision to retire the aircraft early and reflects the decision to not continue proposed new investments, as well as the drawdown on aircraft and engine 'hours in the bank', serviceable repairable item stocks and consumable spares stocks.

Level of Capability

21. The F-111 aircraft's ability to operate in our region, in concert with F/A-18 escort aircraft, is currently assessed as excellent. However, the F-111 electronic warfare self protection (EWSP) capability will degrade beyond 2010, when obsolete systems will need replacement and when taken in concert with the increasing regional threat the survivability of the F-111 beyond 2010 is threatened. During this period the F/A-18 will be undergoing major upgrades and while the overall level of capability should be extremely good, there is a risk that the upgrade process may cause restrictions in F/A-18 availability.

22. The F-111 can deliver unguided 500lb and 2000lb "dumb" bombs or short-range laser guided bombs (LGB) in clear weather during day and night. It will be able to deliver up to two medium range (less than 100km) AGM-142 inertial guided standoff missiles with man-in-the-loop terminal homing via datalink with target information acquired via an imaging infrared seeker. Typical maximum weapons load and typical weapons loads are shown in Table 2 with each row indicating a possible weapons load.

Weapon	**Capacity**	**Typical**	
		Air to Ground	Air to Air Missile
Unguided 500lb bomb	24 x low drag	12	2
	20 x high drag	12	2
Unguided 2000lb bomb	4	2	2
Laser Guided 500lb	10	6	2
Laser Guided 2000lb	4	2	2
AGM-142	2	1	2

Table 2 – F-111 Weapons Loads

23. Our strike capability now (or just after introduction of AGM-142) will enable a small

number of F-111 and F/A-18 aircraft delivering the strike role with which we are able to:

- attack a limited number of targets in high threat areas restricted by F/A-18 ranges when supplemented by limited B707 Air to Air refuellers,
- strike using weapon delivery by overflight or at AGM-142 standoff ranges,
- retain a low level of situational awareness delivered through JORN and other national/coalition assets limited by voice transmission of data (no link 16, no AEW&C and current generation Interrogation Friend or Foe (IFF)),
- retain air to air superiority through the F/A-18 capability,

but limited by:

- the capacity to penetrate sophisticated surface to air missile threats, and
- shortfalls in tanker availability limiting the combat fuel radius of the F/A-18 causing ingress at medium levels only.

ENHANCED STRIKE CAPABILITY (CIRCA 2010)

24. Following retirement of the F-111 fleet and completion of F/A-18 upgrades, the strike capability will be transitioned to both F/A-18 and AP-3C. F-111 aircraft currently provide both maritime and land strike capability, offensive air support of land forces as well as a tactical reconnaissance capability. F/A-18 air control capability against regional threats is improving with the introduction of the Advanced Medium Range Air to Air Missile (AMRAAM) beyond visual range weapon. The Hornet capability will be further enhanced on completion of the various system development phases of Air 5376 Hornet Upgrade Program, in particular following integration of the Helmet Mounted Cueing System. The F/A-18 electronic warfare self-protection capability is being upgraded while a Link 16 datalink will be fitted allowing the F/A-18 to integrate into the ADF system.

25. Land strike will be predominantly transferred to the F/A-18 through integration of the all weather day and night bombing capability and the long-range standoff missile. The AP-3C will also have the long-range standoff missile integrated, predominantly for the lower threat littoral strike requirement but it will have a credible land strike capability; albeit not for a high threat environment.

26. Similarly, the maritime strike role will be transferred to both AP-3C and F/A-18. The AP-3C already has a Harpoon capability and the F/A-18 has a latent Harpoon capability. The Hornet capability will be upgraded to provide a full Harpoon capability later in the decade.

27. The tactical reconnaissance capability will be transitioned to the HALE UAV, the AP-3C for lower levels of threat and F/A-18 via its targeting pod.

Level of Capability

28. Following retirement of the F-111 fleet, introduction of AEW&C and the new A330-200 air to air refuelling tanker aircraft, Air Force will be able to:

- attack a significantly larger number of targets than possible today using F/A-18 aircraft supported by the new AAR tanker aircraft at F-111 radius of action ranges,
- strike using precision standoff weapons,

- ingress and egress at low level and off axis should that be necessary,
- retain a medium level of situational awareness provided through the networked system of systems supported by AEW&C and other national/coalition assets, and
- continue development of the doctrine and tactics that will invigorate the system of systems capability,

but will have a limited capacity to penetrate sophisticated surface to air missile threats even though that capability will be better than today.

MATURE AIR COMBAT CAPABILITY (CIRCA 2015)

The Joint Strike Fighter

29. Defence has joined the Systems Development and Demonstration Phase of JSF following an assessment of the available combat aircraft to meet our future air combat requirements. There was a clear distinction between the two fifth-generation air combat aircraft (F-22 and JSF) and the remaining contenders. When affordability and mass is factored into the argument, JSF is the clear contender for meeting Australia's future air combat needs. Air Force is developing a paper to compare the F-22 and JSF capabilities that will be publicly released in August this year.

30. The JSF is being designed to be a true fifth generation multi-role combat aircraft with the following key characteristics:

a. Contain true Low Observable or 'stealth' characteristics. (This means it is designed to have a low radar cross section, low infra-red signature, and low electronic emission levels);

b. Good mission radius, currently in excess of 600nm for the Conventional Take-Off and Landing (CTOL) variant (the CTOL is the most likely variant for Australia);

c. Advanced sensors, comprising an Active Electronically Scanned Array (AESA) radar[1], full coverage ESM system, Electro-Optical Targeting System (EOTS) and Distributed Aperture System (DAS) as well as active EW systems;

d. Highly advanced data fusion capabilities to provide unprecedented situation awareness compared to today's capability;

e. Excellent weapons carriage capability from both internal and external weapon stations;

f. A full suite of precision weapons[2] – air-to-air and air-to-ground – with standoff weapons to be cleared in later blocks;

g. The ability to carry eight Small Diameter Bombs (SDB)[3] internally;

h. Enviable communications capability – both voice and data;

i. Other communications/data link capabilities including Link 16 and a high capacity Interflight Data Link; and

j. F-16/F-18 like manoeuvre performance.

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1 The AESA radar also provides electronic attack capability.
2 Key weapons will be JDAM, JSOW, GBU-12, Mk 82 unguided bombs, AMRAAM, AIM-9X and ASRAAM.
3 GBU 39 Small Diameter Bomb is described in Janes Air Launched Weapons. Carriage of eight SDBs will permit the engagement of up to eight targets in a single pass.

31. Interoperability is one of the design drivers for the project and will be critical to achieving the networked air force as part of the overall ADF network-centric approach to warfare. Interoperability is provided through:

a. Link 16 for provision of communications linkages of aviation and air defence assets,

b. Satellite Communications (SATCOM) enabling beyond line of sight communications - JSF will be the first fighter aircraft with transmit and receive satellite communications capabilities,

c. Integration of ground forces and Joint Forward Air Control (JFAC) assets through the Joint Tactical Radio System (JTRS) functionality and the Joint Variable Message Format (JVMF) protocol, and

d. High capacity Interflight Data Link for covert communication between JSF aircraft in a formation, and

e. Basic communications and navigation systems such as UHF/VHF capabilities for inter-flight and air traffic control voice connection.

32. JSF components and systems will be significantly more reliable than equivalent components on legacy platforms. In addition, the JSF will have an advanced Prognostics and Health Management (PHM) system that is intended to predict failures and estimate life remaining. A significant reduction in maintenance man-hours is anticipated. The JSF is also being designed to maximise maintainability. The maintenance philosophy focuses on removal and replacement of components with limited on-aircraft maintenance and the PHM system will isolate faults to reduce repair time. Improvements in sortie generation rate over legacy platforms are expected to be in the order of 25%.

33. While the Government hasn't made an acquisition decision to sole source for the JSF, Air Force expects that the aircraft will meet our requirements and further expects that a Government decision to acquire the aircraft can be made in about 2006. However, if the JSF does not mature as expected, or fails to meet Australia's requirements, the option remains to recommence the AIR 6000 process for the acquisition of an alternative manned combat aircraft, noting that all the contender aircraft will be quite mature in the 2012 timeframe.

Level of Capability

34. Following introduction of JSF, AEW&C and the new A330-200 tanker aircraft and retirement of the F/A-18, Air Force will be able to

- strike a similar number of targets as previously; however, at extended radius of action ranges,
- strike using standoff weapons (once integrated onto JSF),
- ingress at all levels and off axis should that be necessary,
- conduct electronic attack against air and surface threats in support of mission objectives,
- retain a high level of situational awareness provided through the networked system of systems supported by AEW&C and national/coalition assets,
- use the doctrine and tactics that have invigorated the system of systems capability, and
- maintain an enhanced probability of survivability and success.

SUMMARY OF STRIKE CAPABILITY OVER TIME

35. Over time the level of regional capability will also rise and that will offset some of the gains made with development of the system of systems. Regardless of these offsets, Defence assesses that our level of capability will continue to improve over time and Defence is confident that the overall air combat capability will retain the regional advantage articulated by the Defence White Paper. Figure 3 provides an indication of the level of strike capability that can be delivered over time.

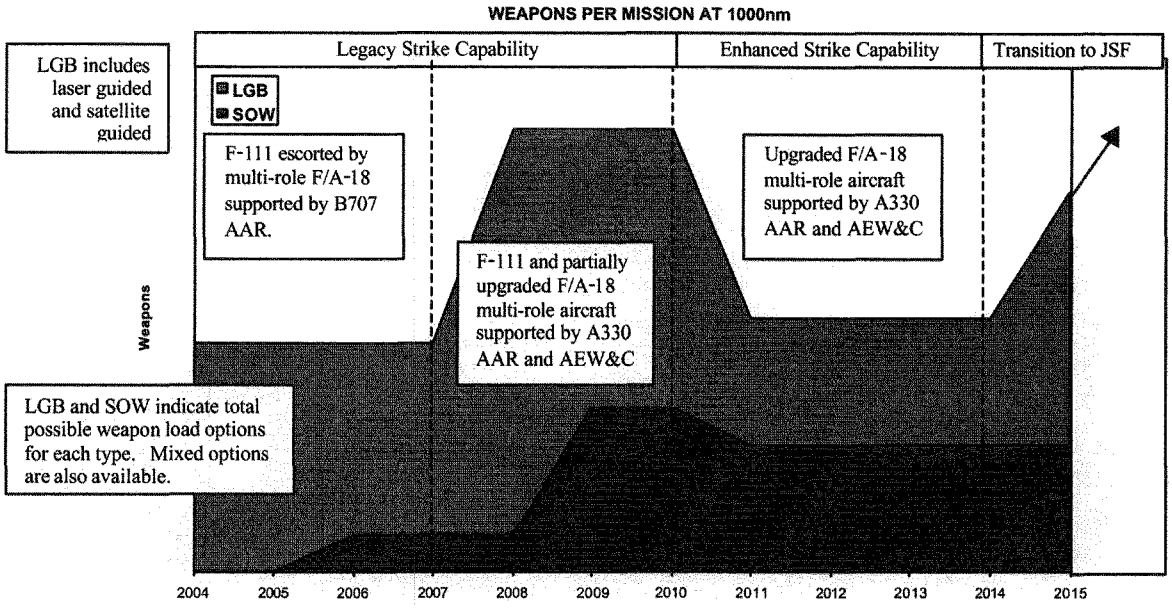

Figure 3 – Level of Precision Strike Capability over Time

MANAGING RISK

F-111 Retirement Requirements

36. The Government has announced that the F-111 will not be retired unless a number of prerequisites are met. These include:

a. Introduction into service of AEW&C;

b. Introduction into service of the new Air to Air Refuelling aircraft;

c. Completion of the Hornet Upgrade Program systems component, particularly the electronic warfare self protection and Link 16 datalink component;

d. Integration of an all weather day and night GPS guided bombing capability onto the F/A-18;

e. Integration of follow on standoff weapon onto F/A-18; and

f. Integration of follow on standoff weapon onto AP-3C.

37. Meeting these prerequisites will place Air Force in a strong position regionally. In future the region may see the progressive introduction of newer Russian and Western sourced fighter/bomber aircraft including Su-30 and Mig-29 derivatives with advanced air to air

weapons and advanced ground based air defence systems supported by modern radars. While the F-111 is currently assessed as being capable in this environment, when escorted by F/A-18s, the cost of maintaining that advantage is distorting the shape of the force. The best way of defeating these systems is by employing the system of systems, to which the F/A-18 can contribute following completion of the Hornet Upgrade Program and integration of Link 16. But no equivalent (or affordable) program exists for the F-111.

JSF Late Delivery

38. The late delivery of JSF would require the extension in service of the air control and strike capability that will be inherent in the F/A-18 by about 2010. The aircraft systems that currently are being upgraded can be expected to be highly competent until at least 2015. Should they be extended beyond 2015, then some additional systems upgrade may become necessary.

39. Fatigue of the airframe is the significant factor that could preclude the F/A-18 from being extended beyond 2015. Fatigue accrual of the fleet is closely managed and significant effort has been expended in determining how much fatigue can be accrued without endangering the ADF's capability. Defence has determined that a minimum of 15 aircraft will need to have their centre barrel assemblies replaced to ensure that a viable fleet can be maintained to the planned life of the aircraft. However, as a hedging strategy, Defence has set aside funding for a total of 43 centre barrel assemblies to allow the life of the fleet to be extended significantly beyond 2015 should that become necessary.

CONCLUSION

40. The decision to retire the F-111 has been made in the best interests of maintaining a strong capability for the Defence of Australia. This will enable the development of a network-enabled capability to be generated to ensure that Australia can maintain parity or better with regional air combat capability into the future. While a strike capability reduction will occur following retirement of the F-111, that level of strike capability will be greater than today's level of capability. It is Air Force's view that the level of strike capability available for any contingency will continually develop over time through greater aircraft availability and enhanced situational awareness created through the implementation of the system of systems. Australia cannot afford to maintain the F-111 in-service at the level of capability required while developing the future force; therefore, the F-111 aircraft will not be part of the future system of systems.

41. A potential reduction of payload and range created by retirement of the F-111 will be offset by:

a. significantly greater availability of F/A-18s due to Air to Air refuelling capacity,

b. integration of Link 16 to provide that enhanced situational awareness provided from the network through the AEW&C,

c. integration of an advanced electronic warfare self-protection suite,

d. enhanced strike ranges following introduction of new A330-200 tanker aircraft and the long-range standoff weapon to both AP-3C and F/A-18, and

e. flexible strike options with the integration of the satellite-guided weapons and new targeting pod.

Consequently, there will be no gap in strike capability during this transition period.

42. The development of the flexible, adaptable, deployable and networked capability is required to support future operations both for the defence of Australia and for offshore contingencies should that become necessary.

A.G. HOUSTON
AIRMSHL
CAF

Jun 04

Annex

A. New Air Combat Capability

Annex A

NEW AIR COMBAT CAPABILITY

Project Background

1. Project AIR 6000, "New Aerospace Combat Capability", was established in 1999 in order to 'identify and acquire new capabilities to replace the Australian Defence Force (ADF) air dominance and strike capabilities currently provided by the F/A-18 and F-111 aircraft fleets'[4].

2. In broad terms, the capability proposed by Air 6000 included:

   a. the air vehicle and its integration within the ADF,

   b. the support system and integration within the ADF and Australian industry, and

   c. necessary Australian industry support capabilities.

3. The capability proposal involved a three-stage capability definition phase followed by up to three acquisition phases. The capability definition stages involved:

   a. Stage 1 (Feasibility Analysis) that assessed F/A-18 and F-111 Life-of-Type capability and cost issues to validate the platforms' planned withdrawal dates.

   b. Stage 2 (Impact Analysis) that conducted force structure analysis of a spectrum of future force mix options, based on available technology, the strategic environment and the available resources, to assess broad affordability and effectiveness. This phase also examined relevant developments in technology and operational concepts and provided decision support to enable selection of a reduced set of realistic force mix options for the Stage 3 analysis.

   c. Stage 3 (Options Definition) that aimed to:

      (1) deliver a range of force structure options that offered decision-makers clear guidance on enhancing ADF capability;

      (2) provide an acquisition strategy that minimises the recurrence of block obsolescence in future years; and

      (3) inform decision-makers of the cost and capability implications of all possible options.

Air 6000 Requirements

4. The requirement for the NACC is established in the Defence 2000 White Paper "Defence 2000: Our Future Defence Force" (DWP2K):

Australia must have the ability to protect itself from air attack, and control the air approaches to ensure that AS can operate effectively against any hostile forces approaching AS. The Government's aim is to maintain the air combat capability at a level at least comparable qualitatively to any in the region, and with a sufficient margin of superiority to provide an acceptable likelihood of success in combat. These forces should be large enough to provide a high level of confidence that we could defeat any credible air attack on Australia or in our approaches, and capable enough to provide options to deploy an air-combat capability to

[4] Defence Capability Plan 2001-2010, Public Version.

support a regional coalition. They will also have the capacity to provide air defence and support for deployed ground and maritime forces in our immediate region.[5]

5. In this context AIR 6000 is a planned, but unapproved project. As agreed by Government in the context of the DWP2K, the Planned Withdrawal Dates (PWDs) for the F/A-18 and F-111 aircraft were 2012-2015 and 2015-2020 respectively. The withdrawal date for the F-111 was subsequently modified to around 2010, as discussed above. Prior to their retirement, the capability provided by these combat platforms must be replaced in order for the ADF to maintain a credible air combat capability. Overall enhancements in capability are likely to be realised, however, through acquisition of a platform offering greater performance, improved reliability, and superior capability against increasingly complex and lethal threat systems

6. Under current guidance, the F-111 and F/A-18 platforms are expected to continue to provide the primary air combat capabilities for the ADF until the proposed introduction of the new air combat capability. While the Lockheed Martin F-35 aircraft is expected to be the solution to the requirement, and as detailed in the White Paper, approximately 100 aircraft are expected to be required, no decision on the actual number or final source selection has yet been made. This selection is not expected to be made until 2006 after approximately three years of detailed analysis. Analysis against the requirements will not focus on the assessment of ability to fulfil the capability of the F-111 and F/A-18 platforms but rather will focus on meeting future capability needs. This will involve identifying future needs and capability gaps, while taking into account the added dimension that other response elements, such as ground and maritime based air defence/strike assets, contribute to the ADF's overall air combat capability.[6]

New Air Combat Contenders

7. The AIR 6000 project included eight manned aircraft options for the new air combat capability. Based on preliminary analysis and as a result of responses to a Request for Information (RFI) and Market Survey in late 2001, the following assessment of their potential to deliver the necessary capability was provided to Government:

a. The first group comprised those aircraft that were strongly recommended to be disregarded due to lack of information or that did not meet critical requirements.

b. The second group comprised those aircraft that should be left in the field and included JSF.

c. The third group comprised those aircraft that, while being capable, have particular attributes which might well be considered by Government to warrant disregarding them in any decision to narrow the field.

Entry into JSF Program

8. On 12 April 2002 Mr Aldridge, Under Secretary Acquisition Technology and Logistics from the US DoD, wrote to the Under Secretary Defence Materiel Organisation advising him of a 15 July 2002 deadline for joining the System Development and Demonstration (SDD) phase of the JSF project. This date was necessary due to the need to get partners 'on-board' for the development of the aircraft.

9. The anticipated advantages of joining the SDD phase of the JSF project were identified

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[5] DWP2K, page 85, para 8.39
[6] NACC Strategic Guidance study, Dr P. Maguire (DSTO) and Dr D. Quinn (DSTO), 2003.

by Defence as primarily:

a. privileged access to information;

b. priority over non-partner customers in the timing of delivery of production aircraft;

c. the expectation of considerable benefits to Australian industry; and

d. financial benefits in terms of net savings to the DCP through reduced cost of acquisition as part of cooperative arrangements.

Additionally, partnership in the development of the aircraft was seen to offer the benefit of improving Australia's ability to acquire an aircraft with a level of capability and technology appropriate to our requirement in terms of both regional superiority and interoperability with the US.

10. Before joining the project Defence was given assurances of the high level of capability that Australia would receive if we were to subsequently acquire the aircraft. (Those assurances have been reaffirmed through classified briefings that have been received since joining the project).

11. Against these benefits the cost of entry as a Level 3 partner had to be considered which was US$150m spread over the 10-year SDD phase.

12. Based on the balance of costs and benefits, on 27 June 2002 Government announced its intention to enter into negotiations to become a level 3 partner. At the same time Government also announced that, due to the advantages provided by the JSF – an affordable, fifth generation, stealthy, multi-role fighter – it was expected that the JSF would replace the capabilities currently provided by the F-111 and F/A-18. Early announcement of the expected way ahead was in part due to the desire to save time and money for competitors that were considered unlikely to be suitable. As the Minister said at the time of announcing the decision to enter negotiations to join the JSF project:

> *"I think it would be unfair to competitors to hold out a carrot that I don't think is really there. Our starting point in this project, this investment in the design and development phase, is our belief on the basis of information that's currently available to us and the advice of the Air Force, that this is the aircraft for us in the future. But the advantage - an advantage in the way we're doing it, as I've said, is that it is a step by step approach and the acquisition decision won't be made until about 2006".*

13. Based on successful negotiation of the Memorandum of Understanding (MoU) covering the SDD phase of the JSF project, on 31 October 2002, Australia joined the project through signing an Exchange of Letters and the MoU. Through the Exchange of Letters between the Minister for Defence of Australia and the Secretary of Defense of the United States of America, the Government identified the expected long-term capability and industry outcomes for Australia. Government reaffirmed its expectation that the JSF would be the manned aircraft for Australia's new air combat capability but an acquisition decision was not expected until around 2006 after detailed analysis of the aircraft's capability and successful progress of the project.

14. Subsequent to formal entry into the project, on 25 November 2002 the then Vice Chief of the Defence Force wrote to the producers of alternate aircraft advising them that Defence would no longer be soliciting information from them.

15. As a result of the decision to join the JSF project, the original AIR 6000 project was restructured into two phases:

a. Phase 1 – Definition, Analysis and Risk Mitigation, leading up to the 2006 acquisition decision; and

b. Phase 2 – Acquisition, broken into three sub phases, 2A, 2B and 2C.

16. Phase 2A and 2B are expected to be based on JSF aircraft and Phase 2C will acquire either additional JSF aircraft or complementary systems focusing on the strike role. Complementary systems currently being considered include Uninhabited Combat Air Vehicles (UCAV), advanced weapons for the JSF and cruise missiles from long range non-penetrating aircraft.

The Joint Strike Fighter

17. The JSF is being designed to be a true multi-role combat aircraft with the following key characteristics:

a. A true Very Low Observable or 'stealth' characteristics. (This means it is designed to have a very low-radar cross section, low infra-red signature, and low electronic emission levels);

b. Good mission radius, currently in excess of 600nm for the Conventional Take-Off and Landing (CTOL) variant (the CTOL is the most likely variant for Australia);

c. Advanced sensors, comprising an Active Electronically Scanned Array (AESA) radar[7], full coverage ESM system, Electro-Optical Targeting System (EOTS) and Distributed Aperture System (DAS);

d. Highly advanced data fusion capabilities to provide unprecedented situation awareness;

e. Excellent weapons carriage capability from both internal and external weapon stations;

f. A full suite of precision weapons[8] – air-to-air and air-to-ground – with standoff weapons to be cleared in later blocks;

g. The ability to carry eight Small Diameter Bombs (SDB)[9] internally;

h. Unprecedented communications capability – both voice and data;

i. Other communications/data link capabilities including Link 16 and a high capacity Interflight Data Link; and

j. F-16/F-18 like manoeuvre performance.

18. Interoperability is one of the design drivers for the project and will be critical to achieving the networked air force as part of the overall ADF network-centric approach to warfare. Interoperability is provided through:

a. Link 16 for connection of aviation and air defence assets,

b. Satellite Communications (SATCOM) enabling beyond line of sight

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7 The AESA radar also provides electronic attack capability.
8 Key weapons will be JDAM, JSOW, GBU-12, Mk 82 unguided bombs, AMRAAM, AIM-9X and ASRAAM.
9 GBU 39 Small Diameter Bomb is described in Janes Air Launched Weapons. Carriage of eight SDBs will permit the engagement of up to eight targets in a single pass.

communications - JSF will be the first fighter aircraft with transmit and receive satellite communications capabilities,

c. integration of ground forces and Joint Forward Air Control (JFAC) assets through the Joint Tactical Radio System (JTRS) functionality and the Joint Variable Message Format (JVMF) protocol, and

d. high capacity Interflight Data Link for covert communication between JSF aircraft in a formation, and

e. basic communications and navigation systems such as UHF/VHF capabilities for inter-flight and air traffic control voice connection.

19. JSF components and systems will be significantly more reliable than equivalent components on legacy platforms. In addition, the JSF will have an advanced Prognostics and Health Management (PHM) system that will predict failures and estimate life remaining. A significant reduction in maintenance man-hours is expected if the PHM performs as predicted. The JSF is also being designed to maximise maintainability. The maintenance philosophy focuses on removal and replacement of components with limited on-aircraft maintenance and the PHM system will isolate faults to reduce repair time. Improvements in sortie generation rate over legacy platforms are expected to be in the order of 25%.

20. While the Government hasn't taken an acquisition decision to sole source for the JSF, Air Force expects that it will meet our requirements and further expect that a decision to acquire the aircraft will be made in about 2006. However, if the JSF does not mature as expected, or fails to meet Australia's requirements, the option remains to recommence the AIR 6000 process for the acquisition of an alternative manned combat aircraft, noting that all the contender aircraft will be quite mature in the 2012 timeframe.

AIR FORCE RESPONSE TO

DR CARLO KOPP'S

A CASE OF CONVOLUTED REASONING

(An article from HEADSUP 306)

The De fence Watch public briefing provides some interesting insights into the thinking of the Defence bureaucracy – especially its capacity to accept obvious contradictions in its own reasoning.

The biggest contradictions lie in thinking on Beyond Visual Range air combat.

Defence observed that combat within visual range with two equal combatant's leads to "mutually assured destruction"... "We believe you need to be out there engaging Beyond Visual Range." The premise that close-in combat is non-viable is reasonable. Exchange rates have historically been at low rates using ambush tactics, including modern BVR combat.

However, the exceptional off-boresight and high G capability now in close combat missiles will increasingly become a feature of BVR missiles.

Modern BVR combat involves getting off the first shot. Advantages go to players with bigger radars, longer ranging missiles, lower radar signatures, bigger fuel loads and higher sustained speeds.

Air Force Comment: The advantage in BVR combat goes to the aircraft with the ability to detect first, shoot first and kill first – this doesn't necessarily rely on bigger radars, longer ranging missiles or lower radar signature and higher fuel loads although may contribute in some circumstances. Being able to detect first depends on relative radar efficiency, which is a trade off between radar power, range to target and radar cross section of target. The ability to shoot first is a balance between the ability to detect the target and the missile range and performance. Kill first is a balance between being able to detect first, shoot first and then the ability of the weapon to reach and destroy the target in the fastest time. The play off between these parameters is much more complex than the article portrays and the overall F-111 capability is not better than a modern fighter aircraft but is significantly worse in this area of the combat arena.

Fuel is energy; energy is life.

Air Force Comment: More fuel and energy contribute to the BVR capability; however, if the fuel burn rate is higher than the opponent then the amount of fuel required to be carried to retain parity must be increased. Combat persistence is the correct term. The F-111 carries three times the payload in fuel of the F/A-18 but in the high-end air defence role it also burns fuel at three times the rate of the F/A-18. Furthermore, high speed ingress can make an aircraft more vulnerable to counter attack than a slower speed aircraft depending on the circumstances.

Speed is especially valuable as it permits opening and closing distances as quickly as possible to defeat opposing weapons kinematically, provide firing opportunities early, and improve missile range.

Air Force Comment: Speed is only useful if it doesn't allow the threat aircraft to detect you before you can detect it. Detection is dependent on radar power, radar cross section and range. As an example, a FOXBAT at Mach 2.2 with inferior Radar, ECCM and BVR missile will be beaten by the Mach 1.2 Hornet.

The US Air Force F/A -22A tops the pack in precisely these parameters – recently a sole F/A-22A defeated five F-15Cs in a trial engagement.

Air Force comment: We agree

If BVR combat will dominate future operations, two immediate contradictions in current Defence bureaucracy thinking emerge.

The first is that the reduced stealth export JSF will be a viable player in this game – its BVR survivability depends on its X-band stealth capability, as it is not a high performance high speed design.

Air Force Comment: BVR survivability is dependent on radar detection range (combination of radar power and target RCS) and missile probability of kill (Pk) (an combination of missile speed, manoeuvrability, terminal guidance and warhead performance) Reducing the RCS by adding stealth features reduces the detection range and missile Pk.

Even if the RAAF were to spend a fortune adding a unique and improved EWSP suite to offset the hobbled stealth, the battlefield strike optimised JSF will never be a strong BVR combat player. The F/A-22A does everything better than the JSF in this game, yet remains ignored in Canberra.

Air Force Comment: The EWSP suite on the JSF will not be inferior and Air Force does not expect to have to replace it. The F/A-22 is the acknowledged leader in the BVR game but Air Force has not ignored it. The F/A-22 is not being developed to provide air to ground capability, and even if that decision is ultimately made, the small numbers that could be purchased by RAAF would ensure a reduced ability to effectively deliver weapons in air and surface modes. Mass is required to create the desired effect for Australia's circumstances.

The second contradiction arises when comparing the F/A-18 family and the F-111. In the BVR combat game, the F- 111 aerodynamically beats the F/A-18 family on all cardinal parameters.

It is much faster, almost twice as fast at the high altitude top end. It carries almost three times the internal fuel of the F/A-18A.

Air Force comment: The cardinal parameters for air combat comparison are many more than speed. Combat persistence at combat speed and weapon probability of kill are the key comparators.

No less importantly, the F-111 can be driven down to a lower radar signature than an F/A-18A-B, as it can carry stores in its internal bay and its shaping is much easier to treat with radar absorbent laminates or coatings.

Air Force Comment: This statement is simply untrue. While the F-111 frontal RCS can be reduced, even small off boresight angles make the aircraft a major reflector and its construction does not lend itself to RCS reductions. The smaller size of the F/A-18 results in a smaller RCS than the F-111 and RCS reductions on the F/A-18 are more achievable.

The F-111 also has a much larger radar bay sized for the F-14's AWG-9 radar, a legacy of its early role definition as a BVR interceptor. With short wingtips, some off-the-shelf stealth treatments, off-the-shelf internal trapeze missile launchers, and an off-the-shelf radar like the APG-79 or APG-80, the F-111 beats the F/A-18 family as a BVR fighter.

Air Force Comment: The cost of each of these options adds significantly to the cost and risk of developing and retaining the F-111 and are not cost effective options. There is no such thing as a simple upgrade to combat aircraft.

With multimode radars about US$2.5 M apiece, such an upgrade is neither expensive nor complicated.

Air Force Comment: The cost of the radar will be a small portion of the cost of integrating this radar onto the aircraft. As an example, changing radars on F/A-18 has required changing displays which recognised new integration of other equipment which interacted with that display. Our experience with F-111 indicates that integrating any new equipment on the F-111 is extremely expensive and risky.

Survivability arguments by Defence contain further contradictions: "We would have to escort the F-111 with F/A-18 Hornet aircraft, equipped with the right sort of weapons. [and] ...in the sort of environment that's likely to be out there in the future, you 're always going to have to escort the F111." Claiming the need to escort the F-111 is nonsense.

Air Force Comment: This is untrue. The air force has modelling, tactical live exercises and coalition experience, which proves the survivability of F-111 like platforms, increases markedly with an escort.

The alternative of "self escorting" F/A-18 variants is demonstrably non-viable against airborne Sukhoi CAPs, given the Sukhois' radar /missile advantages.

Air Force Comment: Air Force does not believe that opposing regional fighters will have a detect first / shoot first / kill first advantage against our F/A-18.

Therefore in practice both aircraft would need to be escorted under such conditions.

The tankers and Wedgetails supporting the F/A-18 variants would also need to be escorted in such an environment.

Accepting the premise that strike tasked F-111s have to be escorted, but not strike -tasked F/A-18As is self contradictory as it is easier for a Sukhoi to kill a slower F/A-18 variant at 30,000 ft, than a faster F-111 at 200 ft AGL, using a BVR shot.

Air Force Comment: This statement is not true. The F/A-18 will not ingress to the target at 30,000ft. The F/A-18 will know about the threat using information provided by datalink from the AEW&C, but the F-111 will not because it will not be fitted with the appropriate datalink equipment. Speed is not the determining factor in this part of the combat arena.

The physics of missile kinematics and radar look-down performance cannot be escaped.

Air Force Comment: We agree that physics cannot be escaped but without the correct premises and by applying incorrect basic assumptions the wrong answers can be derived. Velocity tracking radars rely on separating the background noise from the target signal by using aircraft Doppler signals. The faster the aircraft goes the better the signal separation and the easier the detection. Operating low does not transfer any protection advantage to the low aircraft unless it can use terrain shielding. Defender tactics should minimise the effect of this advantage. Similarly modern missile capabilities are such that the altitude of the aircraft will have little bearing on the success or otherwise of that missile attack. Air Force acknowledges that aircraft speed when used in conjunction with manoeuvrability and other tactics will enhance survivability.

The lack of intellectual rigour which pervades the Defence bureaucracy's reasoning is at the root of the current force structure crisis and unless overcome will continue to create future problems.

Air Force Comment: There is no force structure crisis. A lack of operational appreciation in this article displays the lack of understanding of the enhanced networked Air Force of the future. This future Air Force will be more capable than the one we have today.

AN AIR FORCE RESPONSE TO

DR CARLO KOPP's

HOW THEY GOT IT WRONG

(An article in HEADS-UP 305)

A single F-111 carrying four JASSM vs a pair of F/A-18's carrying two each exposes one aircraft rather than two.

Air Force Comment: This is true, but does not factor redundancy. If the single F-111 is shot down or has a systems failure all options are lost.

The much faster and low flying F-111 is exposed for a shorter time.

Air Force Comment: The F-111 is not less exposed in the scenario given.

An F-111 with 4 x JASSM at low level at economic fighting speed will burn some 20,000lbs/hr. Given usual fuel safety margins this gives 1.35 hours of flight which equals a radius of action of around 350nm.

In comparison an F/A-18 with 2 x JASSM at high altitude at fighting speed will burn some 8,000lb/hr. Given usual fuel safety margins this gives 1.25 hours of flight which equals a radius of action of around 300nm.

Yes the F-111 can go some 50nm further at combat speed.

The argument also neglects the cost advantages in using one F-111 versus two F/A-18's to do the same job.

Air Force Comment: This is simply not true.
There are two crew members in the F-111 and two crew members in the F/A-18's, therefore no saving in personnel.
The overall running costs to provide the F-111 is significantly greater than the F/A-18.

...those aircraft carrying the stand-off weapon will also be carrying air to air weapons as well, and they can protect themselves.....and they do not have to be escorted.
Defensive fighter escorts are only required where there is a prospect of encountering airborne Sukhois, especially if supported by AWACS.

Air Force Comment: This is a very simplistic statement.
The carriage of air to air weapons on a strike aircraft severely complicates the enemy courses of action.
Should an air to air engagement occur the option to fight and win then continue to target is possible. Without air to air missiles our aircraft must abort or get shot down.

Since the Sukhoi has a decisive BVR radar/weapons range advantage over the heavily loaded and slower F/A-18A. If the strike tasked F/A-18 attempts a head to head BVR engagement, the Sukoi 27/30 wins every time.

Air Force Comment: Inaccurate statement.
The Sukhoi does not have a decisive range advantage over an F/A-18.
Outcomes of flight scenarios during large scale flying Exercises such as Red Flag and Aces North, clearly indicate that survivability of the F/A-18 is a viable outcome.

If we pessimistically assume a minimum of 18 F-111's armed each with four weapons we get a fleet capability to deliver 72 weapons to about 1000nm. As available tanker numbers limit the number of F/A-18's available for the strike role. Using four tankers we optimistically get around 24 to 28 useable F/A-18's each with two weapons for a total of 48 to 56. At best the F/A-18/tanker solution provides about 75% of capability inherent in the F-111.

Air Force Comment: There are only 16 F-111C aircraft available. Normal operational serviceability rates for the F-111 would indicate the number of aircraft available for a single strike to be much lower than 16.

Australia needs significant growth in overall strike capability. That alone is a compelling argument not to chop RAAF strike capability by F-111 retirement.

Air Force Comment: The upgrades to the F/A-18, the addition of the A330 air to air refuellers and the addition of the AEW&C does provide an overall increase in the Air Forces ability to conduct strike. In fact the capability to conduct effective precision strike increases dramatically by the network effect and the improvement in data transfer.

JTIDS, LINK 16 is available in stand-alone terminals or combined TACAN/JTIDS/MIDS terminals. All terminals will be soon available as software radios.....integrating such terminals into the existing F-111 avionics system is a small engineering task.

Air Force Comment: This statement underestimates the complexity of integration tasks onto the 1960's architecture of the F-111. For example, there has been considerable effort required during the integration of the AGM-142 by a world-class aerospace contractor.

Adding new EWSP equipment and networking capabilities are incremental tasks – by definition these cannot be called 'another full avionics update'

Air Force Comment: Again this statement reflects an underestimation of the complexity of integration. It is not just the hardware that can be attached to the aircraft. New electronic equipment needs connection to power, environmental systems (heating and cooling) and the data bus and displays of the aircraft. The equipment also requires extensive software development, integration with existing systems and operational testing.

The ALR –2002 warning receiver is a 'drop-in' replacement for the ALR-62 and the existing bays for the ALQ-94/137 can easily fit replacement jammers if the recently added Elta 8222 jammer pod is deemed inadequate.

Air Force Comment: Again this statement is focussed on physical dimensions and does not include the extensive cost and complexity of integrating new equipment and software onto the F-111 in a way that maximises aircrew survivability.

The Block C-4 upgrade sees Mil-STD 1760C interfaces fitted, providing compatibility with all new generation munitions – this money has already been largely spent, unlike the F/A-18 upgrade.

Air Force Comment: This statement is broadly correct.

It would be an incredibly expensive undertaking for an aircraft that is basically '60's technology; 60's technology means that it is very difficult to maintain and to get a large number of aircraft on the line ready for operations. This directly contradicts the earlier comments in the same briefing about outstanding F-111 availability.

Air Force Comment: The cost to maintain and operate the F-111 has increased as the aircraft has increased across the aircraft's life in the RAAF.
The comment relating to outstanding availability is partially due to completion of the avionics upgrade program that is now delivering real benefits in terms of on line availability, but it also relates to the most recent improvements in availability after the F-111 wing and fuel tank issues have been largely resolved. There is no contradiction as the comments are unrelated.